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INTERMOUNTAIN REGION

AN EVALUATION OF PINE BUTTERFLY[1/] POPULATIONS ON THE BOISE, CARIBOU, PAYETTE, AND SALMON NATIONAL FORESTS, AND ON ADJACENT STATE AND PRIVATE LANDS 1983

by

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ABSTRACT

In 1983, ponderosa pines occupying 16,280 acres on the Boise and Salmon National Forests and adjacent state and private lands were defoliated. Numerous adult butterflies were also reported on the Payette National Forest and, for the first time, in lodgepole pine stands on the Caribou National Forest. Population evaluations indicate that defoliation in 1984 will continue to be localized with intensity predicted to range from negligible to moderate.

INTRODUCTION

Pine butterfly, *Neophasia menapia* (Felder & Felder), occurs in ponderosa pine stands across the western United States (Cole 1971). Populations of this insect occasionally reach high levels resulting in severe tree defoliation. The earliest documented defoliation by this insect was in 1882 near Spokane, Washington where nearly all foliage had been stripped from host trees (Hopkins, 1907). Other outbreaks occurred in 1898 and 1907 in the Boise Basin and near Alpha, Idaho, respectively. More recently, Evenden (1940) studied the impacts of an outbreak which occurred in 1922 around the Payette Lakes, and Cole (1956) documented control measures employed to suppress a 1953 outbreak between Deadwood Reservoir and the Middle Fork of the Boise River.

1/ *Neophasia menapia* (Felder and Felder) (Lepidoptera: Pieridae)

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The most recent pine butterfly infestation in southern Idaho began in 1981 when a single area of 500 to 600 acres of ponderosa pine was defoliated south of Dry Buck Summit on the Boise National Forest (Thier 1982). In 1982, defoliation around Dry Buck Summit intensified, and a new area of defoliation was discovered on state and private lands north of Cascade, Idaho (Thier 1983).

The effects of defoliation by pine butterfly have received little attention and reports are somewhat contradictory. Evenden (1940) found 26 percent of his sampled trees died following an outbreak of pine butterfly in 1922. Of these trees he stated that 12 percent were killed due only to defoliation and 14 percent were killed by subsequent bark beetle attack. In contrast, Cole (1966) reported less than two percent of his sampled trees died following the 1952-54 outbreak. Both authors (Cole 1966, Evenden 1940) examined mean annual radial growth and found similar results; a reduction of expected normal growth increment by approximately 39 percent.

In this evaluation we report on the current outbreak in southern Idaho. Data concerning population status, effects of predation and parasitism, and defoliation predictions for 1984 are provided. Data from previous evaluations (Thier 1982, 1983) are included to enable determination of relative change in population size and trends of defoliation indices.

METHODS

Population Status

Detection--As part of the annual regional insect surveillance program, aerial surveys were conducted in the summer, 1983, to detect and record the expanse of pine butterfly defoliation. Field personnel also reported areas of defoliation.

Population Evaluation--To evaluate the population status, we employed the egg sampling techniques outlined by Bousfield and Dewey (1972). Six five-inch apical twigs were collected at midcrown from each of ten trees at each evaluation site and taken to the laboratory for examination.

Selection of evaluation sites was based on areas sampled during previous assessments (Thier 1983) and knowledge of existing pine butterfly activity. We sampled 43 sites on and around the Boise, Caribou, Payette, and Salmon National Forests. Figures 1 through 12 show the location of the sites on and around the Boise and Payette National Forests.

In the laboratory we examined twigs for pine butterfly eggs. Eggs were counted, categorized as viable or nonviable, and the average number of viable eggs per twig computed. Values were then compared with previous evaluations (Thier 1982, 1983) to determine relative change in size of pine butterfly populations.

Predation and Parasitism

Predation--During lab evaluations nonviable eggs, assumed to result from predation, were counted. We used these values to compute the mean number of eggs

destroyed by predation per twig and the percent egg predation. These values indicate the degree of natural predation upon the egg stage of the pine butterfly population.

Parasitism--In early August we determined pupal parasitism rates for the Dry Buck Summit and Arling Hot Springs evaluation sites (Figs. 1 & 2). Over 500 pupae from each site were examined and categorized as being parasitized or nonparasitized. We then computed percent parasitism. We reared approximately 50 pupae from each site to identify the parasite(s).

Predicted Defoliation

To predict 1984 defoliation levels we used the methods developed by Bousfield and Dewey (1972). When we gathered eggs at each evaluation site we computed the percentage of trees with defoliation. This was based on the observed defoliation of 20 host trees around each site. Using this defoliation information and viable egg averages computed earlier, the following equation was used to generate defoliation indices for 1984:

$$Y = -0.0659 + 0.0141\ (X_1) + 0.02\ (X_2),\ \text{where}$$

Y = predicted defoliation index

X_1 = mean number of viable eggs/five-inch twig

X_2 = percentage of trees with current defoliation

So that the defoliation index (Y) is useful in quantifying predicted defoliation, it is converted to predicted percent defoliation and then, for ease of discussion, to defoliation category by interpolation in the following table:

Defoliation Index	Predicted Defoliation (%)	Predicted Defoliation Category
0	0	Negligible
1	25	Light
2	50	Moderate
3	75	Heavy
4	100	Severe

Finally, we compared 1983 and 1984 calculated defoliation indices to indicate defoliation index trends.

RESULTS AND DISCUSSION

Population Status

Detection--Approximately 16,280 acres of light to heavy ponderosa pine defoliation was recorded on and around the Boise and Salmon National Forests in 1983.

This compares with approximately 5,800 acres of moderate to heavy defoliation seen in 1982. The majority of this defoliation (16,200 acres) is on the Boise National Forest and adjacent state and private lands, (Fig. 13) generally in the pine type east of Cascade Reservoir and in the Dry Buck Summit area. Eighty acres of defoliation in the Owl Creek drainage on the Salmon National Forest was reported by field personnel. Thus, defoliation has become much more extensive in 1983 than was observed in 1982 (Thier 1983).

Population Evaluation--We gathered pine butterfly eggs from foliage at 38 of the 43 evaluation sites (Table 1) indicating the infestation is widespread. The only sites where eggs were not found are Bear Run and Station Creek on the Boise National Forest, Boulder Creek on the Payette National Forest, and Caribou City and Olsen Creek on the Caribou National Forest.

Field personnel on the Caribou National Forest reported large numbers of adult butterflies in stands of lodgepole pine. Although we recovered no eggs, we did find a pine butterfly pupa at Caribou City which indicates pine butterfly feeding in the stand.

The highest viable egg counts, those exceeding 20 viable eggs per twig, were from evaluation sites on state or private lands or on the Boise National Forest east of Cascade Reservoir (Table 1). All but one of these sites were sampled for the first time in 1983 after defoliation became evident.

We determined the relative change in the size of the resident pine butterfly populations at evaluation sites sampled in previous years by comparing the mean number of viable eggs in 1983 with previous year's data (Thier 1983). The most dramatic decreases in egg deposition occurred on private lands at Arling Hot Spring Nos. 1 and 2, on the Boise National Forest at Dry Buck Summit Nos. 1 and 2, and to a lesser degree at Anderson Creek on the Payette National Forest (Table 1).

Three-to-five fold increases in viable egg deposition occurred at Lick Creek and Little Pearsol Creek on the Boise National Forest and Colson Creek on the Salmon National Forest. Viable egg counts at all other evaluation sites where comparisons were possible, were much the same as in 1982.

Predation and Parasitism

Predation--Table 2 ranks the evaluation sites by vicinity according to the degree of egg predation. Some degree of predation occurred at 32 of the 43 evaluation sites and ranged from 100 percent at Scriver Creek to zero at a number of sites (Table 2). The importance of egg predation in regulating the pine butterfly is unknown (Cole 1956) but it appears to be responsible for important pine butterfly population reductions at Scriver Creek, Dry Buck Summit #1, and State Plot #1 (Table 2).

Parasitism--As observed by Thier (1983) *Theronia atalantae fulvescens* (Cresson), an ichneumonid wasp, is an important parasite of pine butterfly. Eighty percent of the pine butterfly pupae we examined at Dry Buck Summit were parasitized by this wasp. This represents a 16 percent increase in parasitism by

Table 1. Mean number of viable pine butterfly eggs per five-inch twig - 1981, 1982, 1983

Evaluation Site	Ownership[1/]	Mean No. Viable Eggs/Five-Inch Twig		
		1981[2/]	1982[3/]	1983
Boise N.F.				
Arling Hot Spring #1	pvt	N.S.[4/]	39.47	2.10
Arling Hot Spring #2	pvt	N.S.	48.25	6.35
Bear Run	NF	0.00	0.17	0.00
Cow Creek	NF	0.37	0.00	0.30
Crown Point	pvt	N.S.	N.S.	55.07
Dry Buck Summit #1	NF	33.67	10.52	0.31
Dry Buck Summit #2	NF	N.S.	13.40	0.58
Grandjean Junction	NF	N.S.	N.S.	10.65
Harris Creek Summit	NF	0.27	0.65	1.06
Henry's Creek	pvt	0.00	0.00	0.12
Lick Creek	NF	0.10	2.30	7.30
Little Cayuse Creek	NF	N.S.	N.S.	1.35
Little Donner	pvt	N.S.	N.S.	24.31
Little Pearsol Creek	NF	0.40	4.37	20.58
North Fork Rabbit Creek	NF	0.13	0.72	0.42
Pearsol Creek	NF	2.35	19.73	16.47
Scriver Creek	NF	0.29	0.00	0.00
Smalley Reservoir	IDL	N.S.	N.S.	23.33
State Plot #1	IDL	N.S.	N.S.	5.28
State Plot #2	IDL	N.S.	N.S.	7.72
State Plot #3	IDL	N.S.	N.S.	23.55
State Plot #4	IDL	N.S.	N.S.	12.30
State Plot #5	IDL	N.S.	N.S.	6.13
State Plot #6	IDL	N.S.	N.S.	27.10
State Plot #9	IDL	N.S.	N.S.	37.25
State Plot #10	IDL	N.S.	N.S.	1.70
State Plot #11	IDL	N.S.	N.S.	1.05
State Plot #12	IDL	N.S.	N.S.	2.01
State Plot #13	IDL	N.S.	N.S.	2.90
State Plot #14	IDL	N.S.	N.S.	2.21
State Plot #15	IDL	N.S.	N.S.	3.13
State Plot #16	NF	N.S.	N.S.	29.98
Station Creek	NF	0.20	0.15	0.00
West Fork Six Mile Creek	NF	0.00	0.47	0.13
Caribou N.F.				
Caribou City	NF	N.S.	N.S.	0.00
Olsen Creek	NF	N.S.	N.S.	0.00
Payette N.F.				
Anderson Creek	NF	N.S.	6.83	1.23
Boulder Creek	pvt	0.00	0.02	0.00
Brown's Pond	IDL	0.00	0.20	0.33
Railroad SAddle	NF	0.00	0.20	0.38
State Plot #7	pvt	N.S.	N.S.	14.25
State Plot #8	pvt	N.S.	N.S.	14.87
Salmon N.F.				
Colson Creek	NF	N.S.	2.77	11.68

1/ pvt - private, NF - National Forest, IDL - Idaho Dept. of Lands
2/ Data from Thier 1982
3/ Data from Thier 1983
4/ N.S. - not sampled

Table 2. Pine butterfly egg predation on the Boise[1/], Caribou, Payette[1/] and Salmon National Forests - 1983

Evaluation Site	Ownership[2/]	Mean Number of Eggs/Five-Inch Twig		Percent Egg Predation
		Total Eggs	Destroyed by Predation	
Boise N.F.				
Scriver Creek	NF	0.10	0.10	100.00
Dry Buck Summit #1	NF	0.88	0.57	64.77
State Plot #1	IDL	12.15	6.87	56.54
Arling Hot Spring #2	pvt	11.15	4.80	43.05
State Plot #2	IDL	13.40	5.68	42.39
Arling Hot Spring #1	pvt	3.00	0.90	30.00
State Plot #3	IDL	32.08	8.53	26.59
Smalley Reservoir	IDL	30.90	7.57	24.50
State Plot #16	NF	39.32	9.33	23.73
State Plot #4	IDL	15.68	3.38	21.56
Lick Creek	NF	9.17	1.87	20.39
Grandjean Junction	NF	12.88	2.23	17.31
Little Donner	pvt	28.46	4.15	14.58
State Plot #5	IDL	7.05	0.92	13.05
State Plot #9	IDL	41.47	4.22	10.18
Little Pearsol Creek	NF	22.88	2.30	10.05
Pearsol Creek	NF	18.00	1.53	8.50
North Fork Rabbit Creek	NF	0.45	0.03	6.67
Crown Point	pvt	58.90	3.83	6.51
Harris Creek Summit	NF	1.13	0.07	6.19
Little Cayuse Creek	NF	1.43	0.08	5.59
State Plot #6	IDL	28.77	1.67	5.80
State Plot #10	IDL	1.78	0.08	4.49
State Plot #13	IDL	3.00	0.10	3.33
State Plot #11	IDL	1.08	0.03	2.78
State Plot #12	IDL	2.03	0.02	0.99
State Plot #14	IDL	2.23	0.02	0.90
State Plot #15	IDL	3.13	0	0
Cow Creek	NF	0.30	0	0
Dry Buck Summit #2	NF	0.58	0	0
Henry's Creek	pvt	0.12	0	0
West Fork Six Mile Creek	NF	0.13	0	0
Bear Run	NF	0	0	0
Station Creek	NF	0	0	0
Caribou N.F.				
Caribou City	NF	0	0	0
Olsen Creek	NF	0	0	0
Payette N.F.				
State Plot #8	pvt	17.20	2.33	13.55
Brown's Pond	IDL	0.38	0.05	13.16
State Plot #7	pvt	15.90	1.65	10.30
Anderson Creek	NF	1.25	0.02	1.60
Railroad Saddle	NF	0.38	0	0
Boulder Creek	pvt	0	0	0
Salmon N.F.				
Colson Creek	NF	14.03	2.35	16.75

1/ Includes adjacent state and private lands
2/ NF - national forest, IDL - Idaho Dept. of Lands, pvt - private

T. atalantae over 1982 levels (Thier 1983). We also found *T. atalantae* at Arling Hot Spring where 62 percent of the pine butterfly pupae we examined were parasitized.

We agree with Cole (1956, 1971) that *T. atalantae* represents an important natural control of pine butterfly. Note that with the increased level of parasitism at Dry Buck Summit the pine butterfly egg counts are decreasing (Tables 1 and 2). This inverse relationship is expected as *T. atalantae* is indirectly reducing the number of egg laying adult pine butterflies. We further agree with Cole (1971), based on our parasite evaluations at Dry Buck Summit and Arling Hot Spring, that the parasite population buildup lags one to two years behind the buildup of pine butterfly. Since the literature (Cole 1956, 1971) indicates that *T. atalantae* plays an important role in reducing outbreaks of pine butterfly, and the wasp is presently an important parasite at Dry Buck Summit and Arling Hot Spring, we suspect that it will be found associated with and effective in reducing, pine butterfly population at other evaluation sites.

Predicted Defoliation

Predicted 1984 defoliation levels range from negligible, predicted for 13 of the evaluation sites, to moderate for 21 of the total 43 evaluation sites (Table 3, Figs. 1-12). The evaluation sites which were rated moderate are principally on state or private lands adjacent to the Boise and Payette National Forests.

Lastly, by comparing the 1983 and 1984 defoliation indices (Table 3), we developed defoliation index trends. This was only possible for evaluation sites sampled in both 1982 and 1983.

An upward trend of defoliation is noted at nine areas, but only Lick Creek and Pearsol Creek on the Boise National Forest and Anderson Creek and Railroad Saddle on the Payette National Forest appear important because of the magnitude of change. These evaluation sites may sustain increased defoliation in the future if upward trends continue and natural controls do not become limiting.

A downward trend of defoliation indices was noted at nine other evaluation sites (Table 3) but only Arling Hot Spring No. 2, Dry Buck Summit Nos. 1 and 2, North Fork Rabbit Creek, and Scriver Creek on or near the Boise National Forest appear important because of the magnitude of change. This trend may indicate population collapse and a decrease in defoliation.

MANAGEMENT ALTERNATIVES

Maintain Present Management

Under this alternative, infestations will continue until they decline naturally. Outbreaks usually persist two to five years before they are controlled by natural enemies which are presently increasing in several areas. Tree mortality and reduced growth may occur. In the 1920's defoliation alone

Table 3. Potential defoliation by pine butterfly on the Boise[1], Caribou, Payette[1] and Salmon National Forests in 1984

Evaluation Site	Ownership[2]	1983[3] Defoliation Index	1984 Predicted Defoliation Index	1984 Predicated Percent Defoliation	1984 Defoliation Category	Defoliation Index Trend[4]
Boise N.F.						
Arling Hot Spring #1	pvt	2.1	2.0	50	Moderate	↓
Arling Hot Spring #2	pvt	2.6	1.8	33	Moderate	↓
Bear Run	NF	0.9	0.6	15	Light	↓
Cow Creek	NF	0	0.1	3	Negligible	↑
Crown Point	pvt	N.S.[5]	2.4	60	Moderate	--
Dry Buck Summit #1	NF	2.1	1.4	35	Light	↓
Dry Buck Summit #2	NF	2.1	1.0	25	Light	↓
Grandjean Junction	NF	N.S.	0.9	23	Light	--
Harris Creek Summit	NF	0.1	0.1	3	Negligible	→
Henry's Creek	pvt	0.1	0.2	5	Negligible	↑
Lick Creek	NF	0.2	0.7	18	Light	↑
Little Cayuse Creek	NF	N.S.	0	0	Negligible	--
Little Donner	pvt	N.S.	1.5	38	Light	--
Little Pearsol	NF	1.4	1.1	28	Light	↓
North Fork Rabbit Creek	NF	1.2	0.1	3	Negligible	↓
Pearsol Creek	NF	0.8	2.2	55	Moderate	↑
Scriver Creek	NF	0.7	0.2	5	Negligible	↓
Smalley Reservoir	IDL	N.S.	2.3	58	Moderate	--
State Plot #1	IDL	N.S.	2.0	50	Moderate	--
State Plot #2	IDL	N.S.	2.0	50	Moderate	--
State Plot #3	IDL	N.S.	2.3	57	Moderate	--
State Plot #4	IDL	N.S.	2.1	53	Moderate	--
State Plot #5	IDL	N.S.	2.0	50	Moderate	--
State Plot #6	IDL	N.S.	2.3	57	Moderate	--
State Plot #9	IDL	N.S.	2.5	62	Moderate	--
State Plot #10	IDL	N.S.	2.0	50	Moderate	--
State Plot #11	IDL	N.S.	2.0	50	Moderate	--
State Plot #12	IDL	N.S.	2.0	50	Moderate	--
State Plot #13	IDL	N.S.	2.0	50	Moderate	--
State Plot #14	IDL	N.S.	2.0	50	Moderate	--
State Plot #15	IDL	N.S.	2.0	50	Moderate	--
State Plot #16	NF	N.S.	2.0	50	Moderate	--
Station Creek	NF	0	0.1	3	Negligible	↑
West Fork Six Mile Creek	NF	0.1	0.1	0	Negligible	--
Caribou N.F.						
Caribou City	NF	N.S.	0.3	8	Negligible	--
Olsen Creek	NF	N.S.	1.6	40	Negligible	--
Payette N.F.						
Anderson Creek	NF	0	0.8	20	Light	↑
Boulder Creek	pvt	0.4	0.3	8	Negliglble	↓
Brown's Pond	IDL	0	0.2	5	Negligible	↑
Railroad Saddle	NF	0	0.9	23	Light	↑
State Plot #7	pvt	N.S.	2.1	53	Moderate	--
State Plot #8	pvt	N.S.	2.1	53	Moderate	--
Salmon N.F.						
Colson Creek	NF	0	0.3	8	Negligible	↑

1/ Includes adjacent state and private lands
2/ pvt - private, NF - national forest, IDL - Idaho Dept. of Lands
3/ Data from Thier 1983
4/ Trend: -- unable to establish due to missing data, → static, ↑ increasing, ↓ decreasing. Established from comparison of 1983, 1984 defoliation indices.
5/ N.S. - not sampled

resulted in 12 percent mortality (Evenden 1940) but in the 1950's no mortality due to defoliation alone occurred (Cole 1966). Trees weakened by defoliation may fall prey to bark beetles. The following quote best summarizes the impact of pine butterfly defoliation as recorded by Hopkins (1907):

> "Evidently, while it (pine butterfly) appears at irregular intervals in such vast swarms as to attract general attention and vast areas of pine are often defoliated by the larvae, its natural enemies prevent the continuance of its depredations in any one locality long enough to be independently destructive to the timber; yet it appears that the weakened condition, even a slight defoliation, is sufficient in some cases to attract certain of the destructive bark beetles..."

Losses to bark beetles have ranged from 1.3 to 14.0 percent (Evenden 1940, Cole 1966). In both the 1920's and 1950's outbreaks, a 39 percent reduction in normal growth was measured (Evenden 1940, Cole 1966).

Silvicultural Management

Evenden (1940) stated that tree vigor, prior to defoliation, was important in a tree's ability to recover from defoliation. If tree vigor is maximized through stand management, it then follows that insect and disease impacts will be minimized. We speculate that prescriptions that favor stand species diversity and maximize tree vigor will minimize the effects of defoliation. This is a long-term action alternative and will do little to suppress the current outbreak.

Direct Suppression

The environmental Protection Agency registers only one insecticide, the bacterium *Bacillus thuringiensis* Berliner, for pine butterfly suppression. This insecticide kills the larvae of moths and butterflies without causing direct adverse affects on other plants or animals. Testing conducted in 1973 showed B. thuringiensis to be 92 percent effective in reducing larval pine butterfly populations when applied at the currently registered dosage rate (Dewey et al. 1973). Its effectiveness has been inconsistent when used operationally on other forest pests. If *B. thuringiensis* were applied effectively, we expect the synergistic effect of naturally occurring parasites, predators, and the applied bacterium to be extremely effective in suppressing the pine butterfly.

RECOMMENDATIONS

The "maintain present management" alternative is recommended for the current outbreak. Based on the relative decrease in the size of resident butterfly populations and the increase in the predators-parasite complex at Dry Buck Summit and Arling Hot Spring, the outbreak populations at these two sites should soon collapse. Butterfly populations at other evaluation sites may

expand, but within two to three years will probably also collapse due to natural controls. Thus we do not see significant gain from direct suppression at this time. If significant numbers of trees appear to be threatened a suppression project may be considered. If trees are killed then a sanitation-salvage operation may be considered if economically and environmentally feasible. We further recommend the "silvicultural management" alternative be considered as a long term management strategy.

ACKNOWLEDGMENTS

D. Burnham and C. Johnson of the Caribou and Salmon National Forests, respectively, identified areas of defoliation and pine butterfly flights.

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APPENDIX

Figures 1 through 13

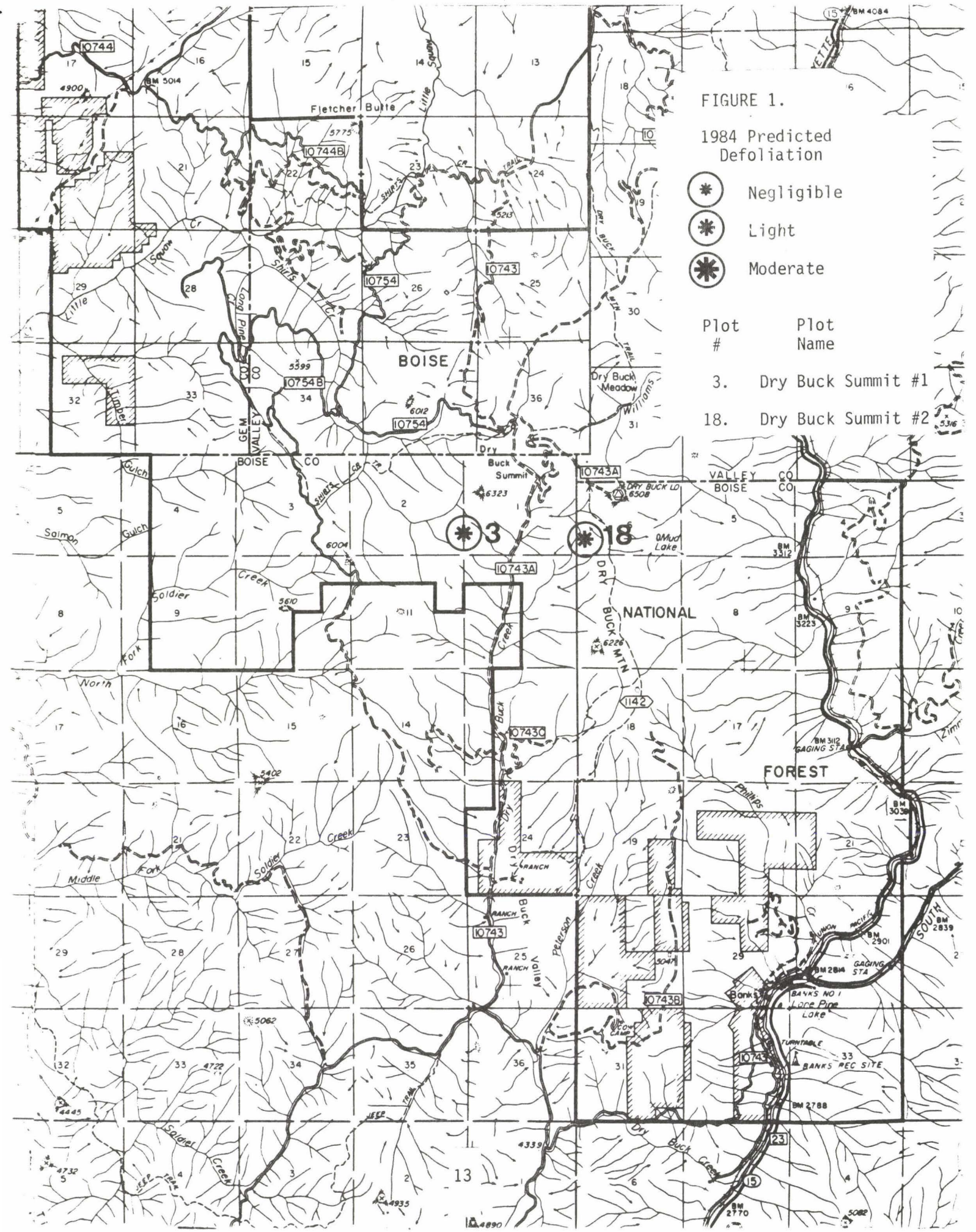


FIGURE 1.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
3. Dry Buck Summit #1
18. Dry Buck Summit #2
BOISE
VALLEY CO
GEM CO
NATIONAL FOREST
Dry Buck Summit
Dry Buck Meadow
Dry Buck Ranch
Mud Lake
Fletcher Butte
Buck Mtn
Banks
Banks Rec Site
Lone Pine Lake
Banks No 1
Gaging Sta
Turntable
Peterson Valley
Middle Fork Soldier Creek
North Fork Salmon Gulch
Little Squaw Cr
Long Prairie Cr
Smiths Cr
Dry Buck Creek
Williams Trail
Jeep Trail
10744
10744B
10754
10754B
10743
10743A
10743B
10743C
10742
10743
10430
1142
3
18

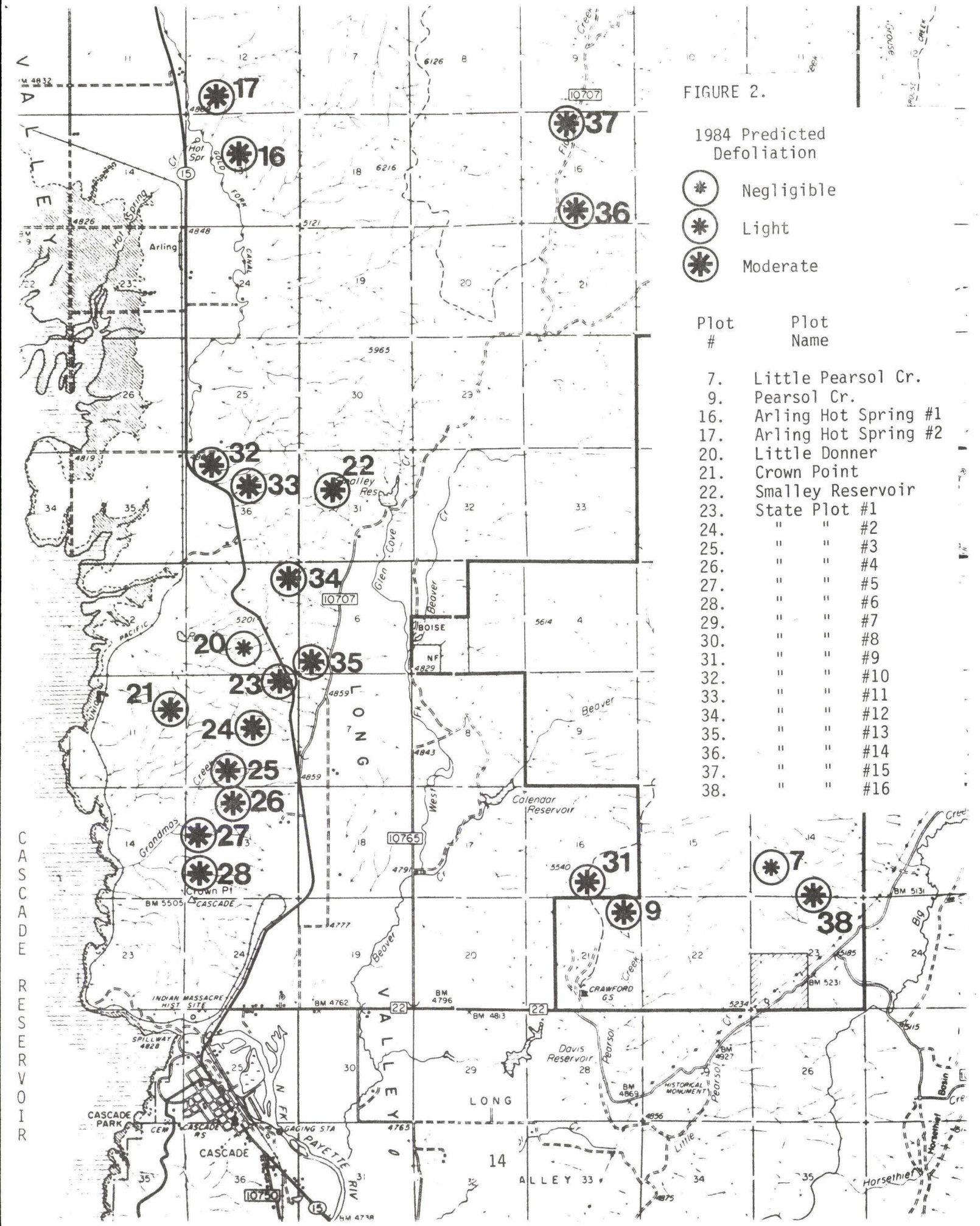


FIGURE 2.

1984 Predicted Defoliation

- Negligible
- Light
- Moderate

Plot #	Plot Name
7.	Little Pearsol Cr.
9.	Pearsol Cr.
16.	Arling Hot Spring #1
17.	Arling Hot Spring #2
20.	Little Donner
21.	Crown Point
22.	Smalley Reservoir
23.	State Plot #1
24.	" " #2
25.	" " #3
26.	" " #4
27.	" " #5
28.	" " #6
29.	" " #7
30.	" " #8
31.	" " #9
32.	" " #10
33.	" " #11
34.	" " #12
35.	" " #13
36.	" " #14
37.	" " #15
38.	" " #16

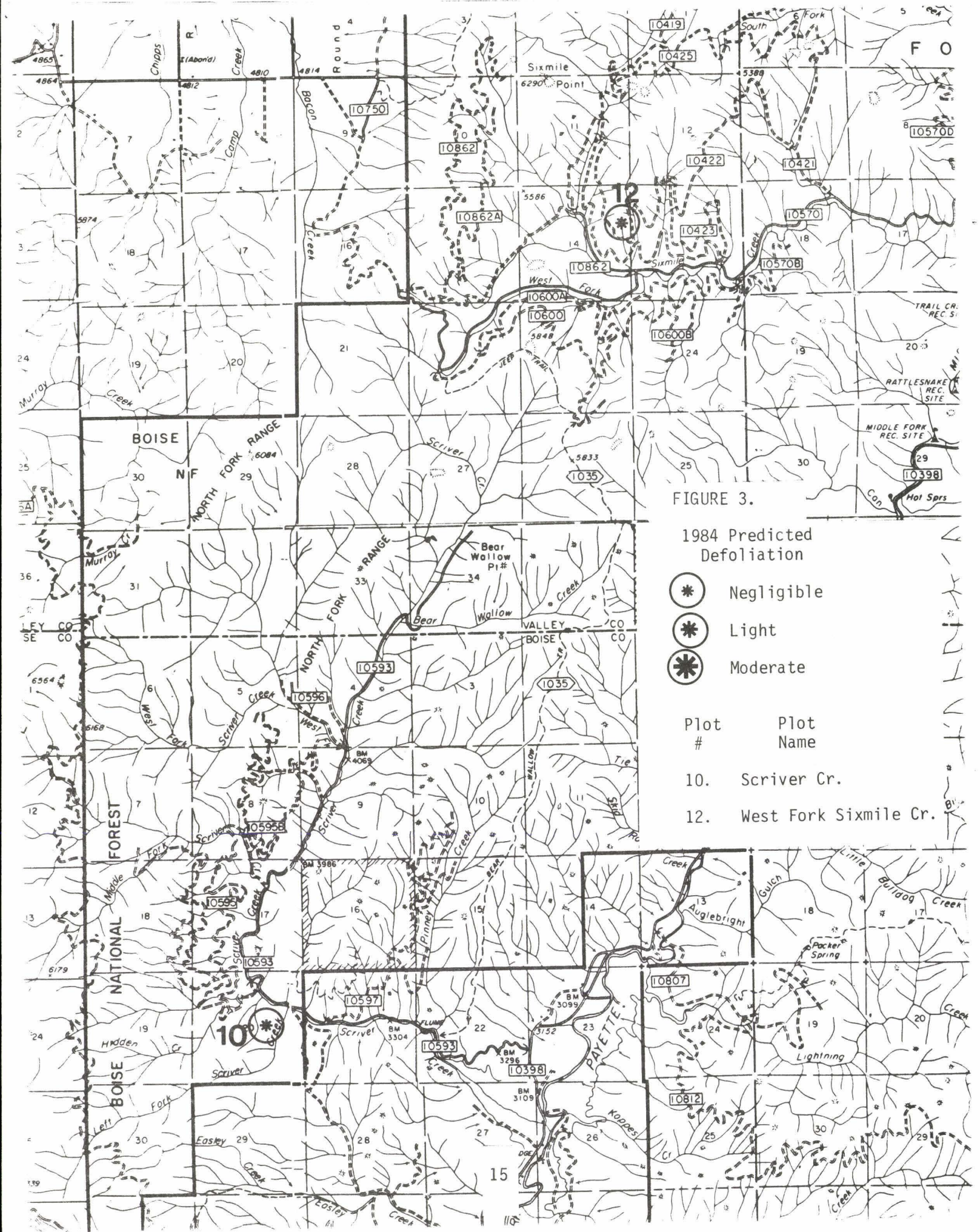


FIGURE 3.

1984 Predicted Defoliation

- Negligible
- Light
- Moderate

Plot #	Plot Name
10.	Scriver Cr.
12.	West Fork Sixmile Cr.

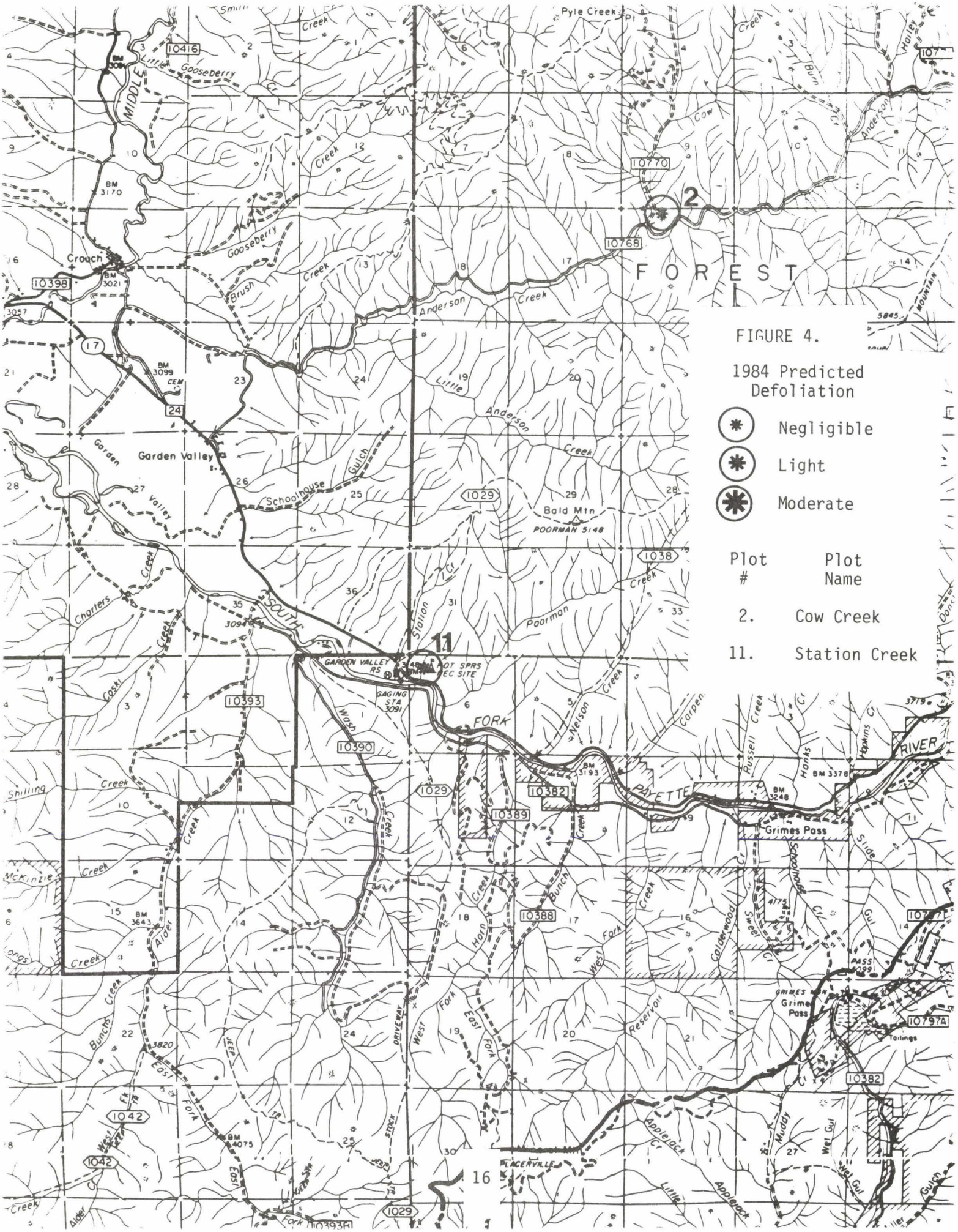


FIGURE 4.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
2. Cow Creek
11. Station Creek
FOREST
Garden Valley
Crouch
Grimes Pass
Bald Mtn
POORMAN 5148
GARDEN VALLEY RS
GAGING STA 3091
PAYETTE
RIVER
FORK
SOUTH
MIDDLE
PLACERVILLE
Pyle Creek
Gooseberry Creek
Little Gooseberry Cr
Brush Creek
Anderson Creek
Little Anderson Creek
Schoolhouse Gulch
Garden Valley
Charters Creek
Poorman Creek
Station Cr
Nelson Creek
Russell Creek
Hooins Cr
Hanks
Shilling Creek
McKinzie Creek
Alder Creek
Bunch Creek
Horn Creek
West Fork
East Fork
Reservoir
Calderwood Cr
Applelock Cr
Little Applelock
Muddy
Wet Gul
Gulch
Tailings
10416
10398
10393
10390
10389
10382
10388
10768
10770
10797A
1042
1029
1038
24
17
16

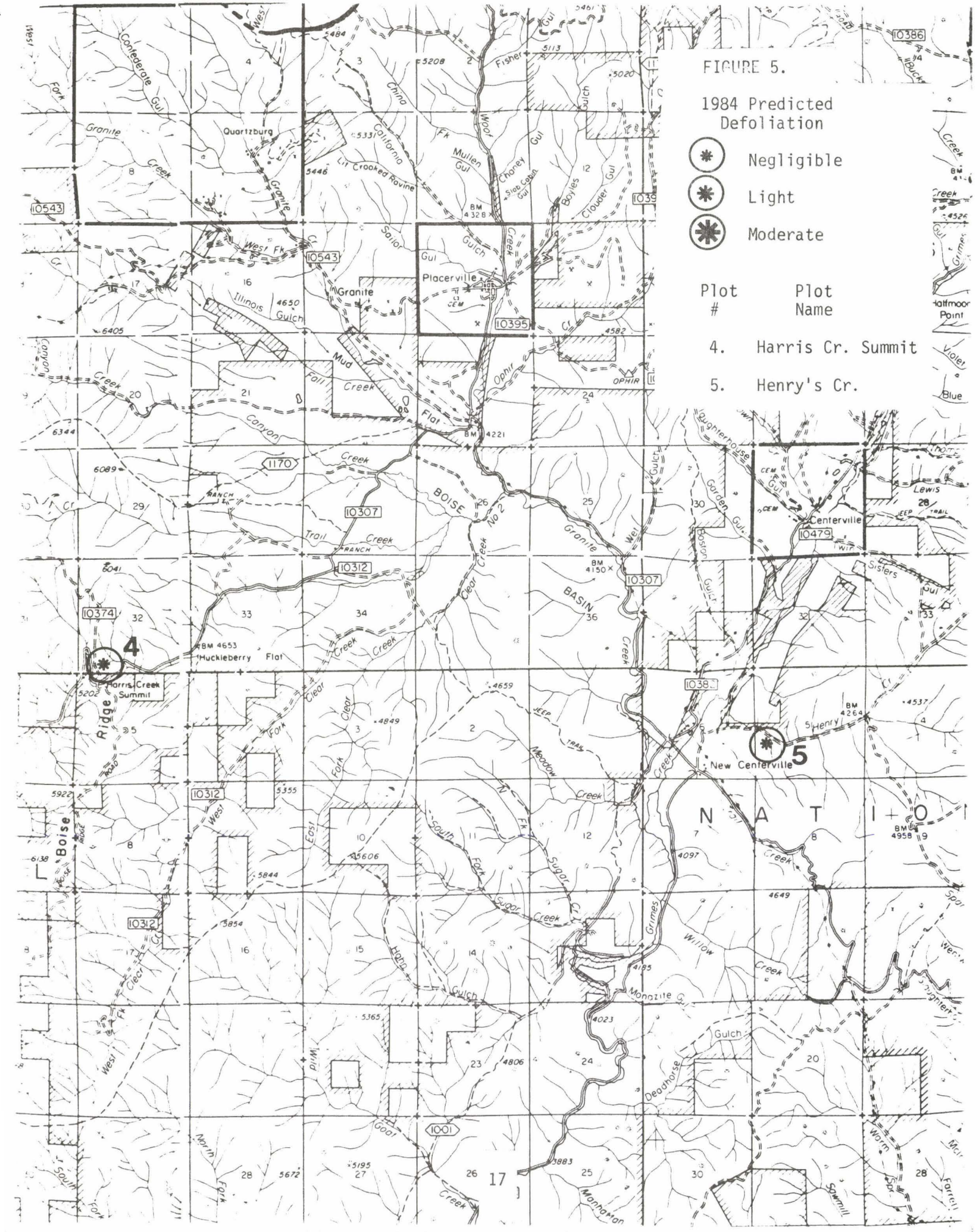


FIGURE 5.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
4. Harris Cr. Summit
5. Henry's Cr.
4
5
Harris Creek Summit
New Centerville
Placerville
Granite
Quartzburg
Centerville
Huckleberry Flat
Ophir
Lewis
Sisters
Boise Ridge Road
Deadhorse Gulch
Monnazite Gulch
Sawmill
Mountain
Willow Creek
Meadow Creek
Sugar Creek
Grimes Creek
Clear Creek
Mud Flat
Fall Creek
Granite Creek
Garden Gulch
Boston Gulch
Slaughterhouse Gulch
Illinois Gulch
Lit Crooked Ravine
Slab Cabin Gul
Chaney Gul
Boyles Gul
Clouder Gul
Fisher Gul
Moore Gul
Mullen Gul
Sailor Gul
Grimes
Halfmoor Point
Violet
Blue
Worm
Farrell
Goat
Wild
Hard
Basin
Trail
Jeep Trail
Ranch
Wtr
Cem
Bm 4328
Bm 4221
Bm 4150
Bm 4653
Bm 4264
Bm 4958
10543
10386
10395
10307
10312
10374
10479
10389
1170
1001
1038
5446
5331
5208
5113
5020
4582
4659
4849
5355
5606
5844
5854
5365
4806
4097
4185
4023
3883
4649
4537
5672
5195
6405
6344
6089
6041
5922
6138
5202
17

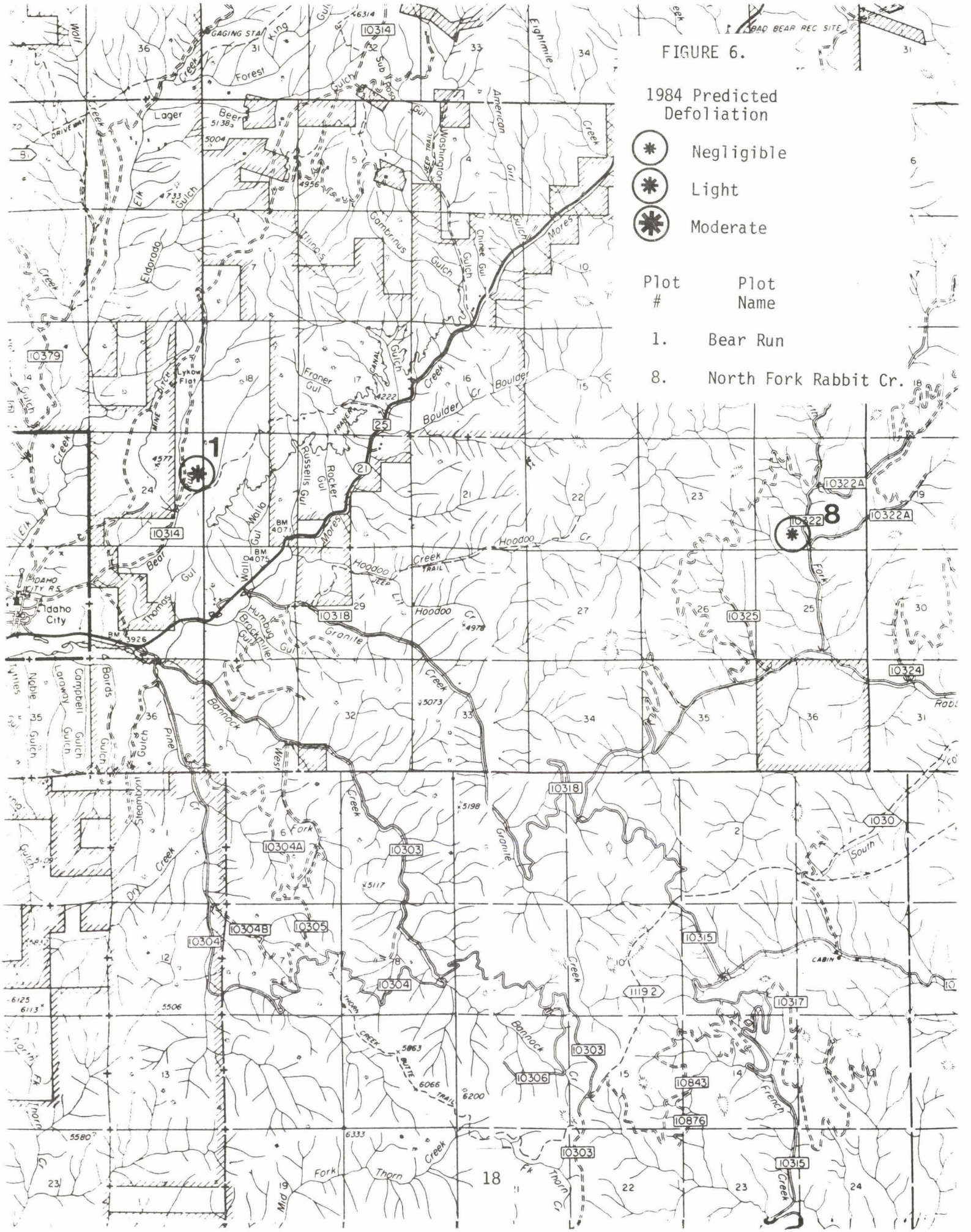


FIGURE 6.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
1. Bear Run
8. North Fork Rabbit Cr.
1
8
Idaho City
Lager
Beer
Eldorado
Elk Creek
Bear Gulch
Mores Creek
Boulder Cr
Hoodoo Cr
Granite Creek
Bannock Creek
Pine Cr
Dry Creek
Thorn Creek
Middle Fork
South Fork
French
Lykow Flat
Humbug Gulch
Steamboat Gulch
Campbell Gulch
Barrels Gulch
Noble Gulch
Lowery Gulch
10314
10318
10322
10322A
10325
10324
10303
10304
10304A
10304B
10305
10306
10315
10317
10030
10379
10843
10876
11192
BM 4071
BM 4075
BM 3926
GAGING STA
BAD BEAR REC SITE
CABIN
TRAIL
JEEP TRAIL

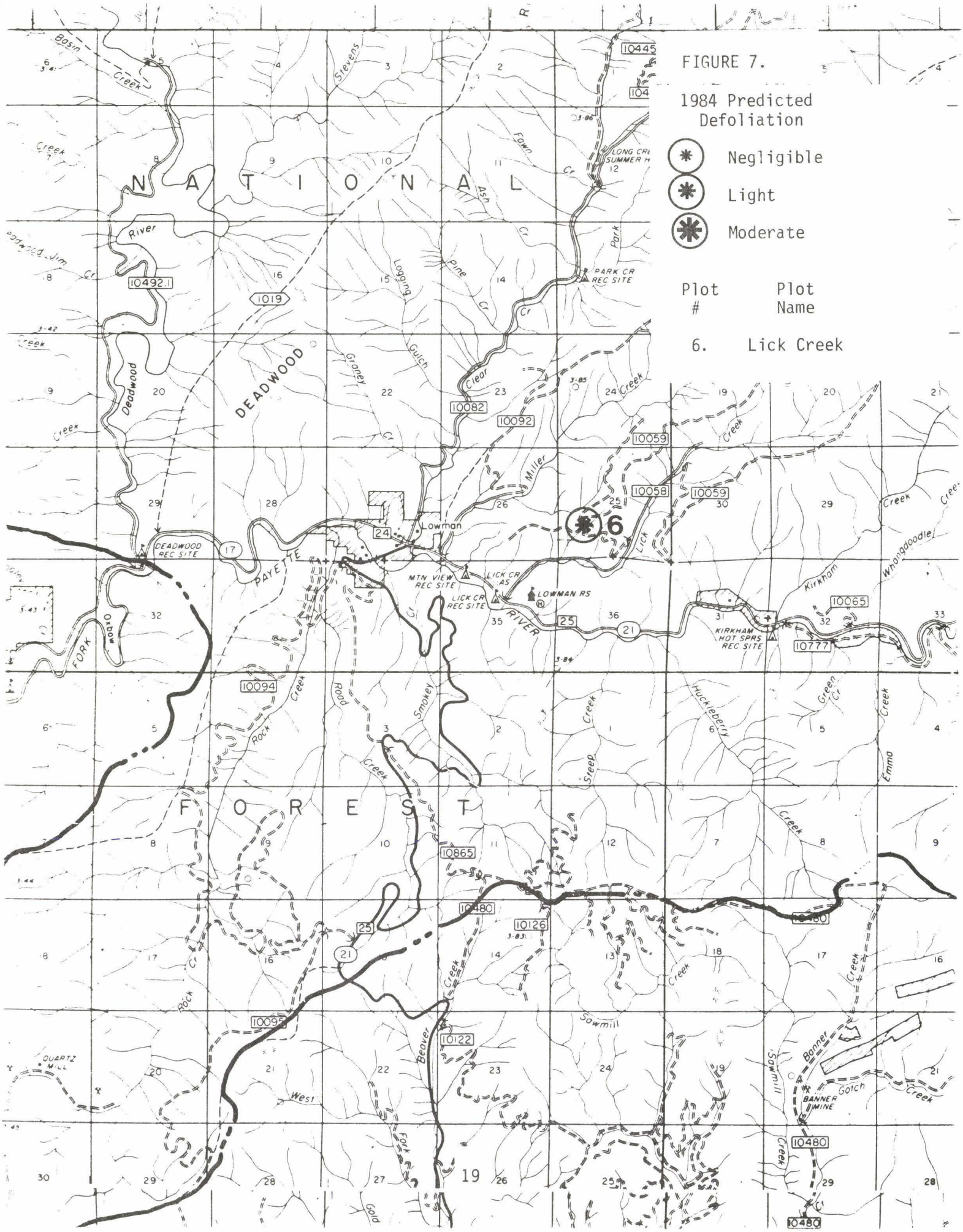


FIGURE 7.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
6. Lick Creek
NATIONAL
FOREST
DEADWOOD
Lowman
DEADWOOD REC SITE
PARK CR REC SITE
MTN VIEW REC SITE
LICK CR REC SITE
LICK CR AS
LOWMAN RS
KIRKHAM HOT SPRS REC SITE
BANNER MINE
QUARTZ MILL
PAYETTE RIVER
Deadwood River
Deadwood Creek
Rock Creek
Smokey Creek
Beaver Creek
Sowmill Creek
Banner Gulch
Lick Creek
Miller Creek
Clear Creek
Graney Gulch
Pine Creek
Ash Creek
Stevens Creek
Basin Creek
Whangdoodle Creek
Huckleberry Creek
Green Cr
Emma Creek
Sleep Creek
Kirkham Creek
Fourmile Creek
Gold Creek
10445
10492.1
1019
10082
10092
10059
10058
10065
10777
10094
10865
10480
10126
10095
10122
24
17
25
21
6
19

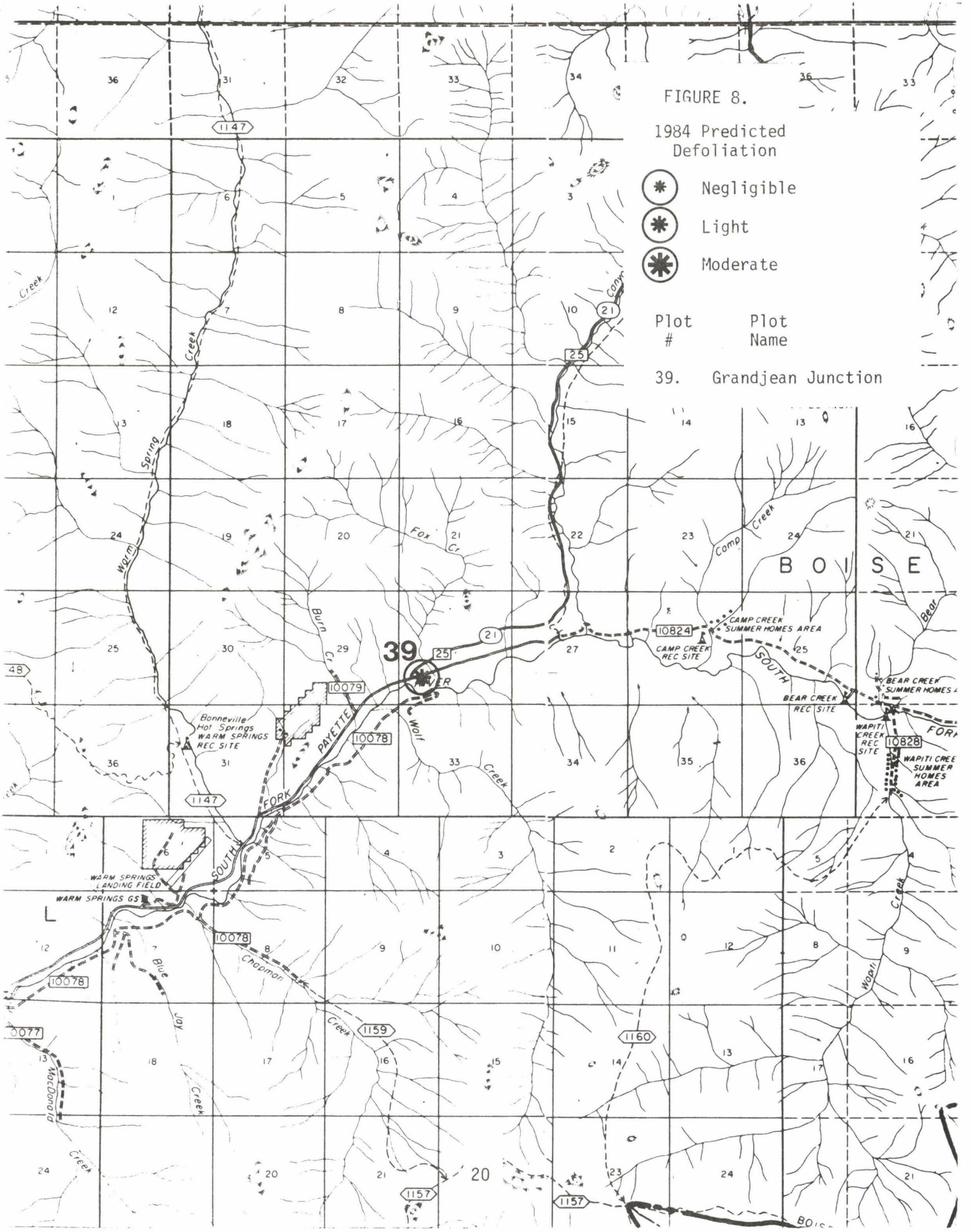


FIGURE 8.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
39. Grandjean Junction
39
BOISE
Warm Spring Creek
Fox Cr
Camp Creek
Burn Cr
Wolf Creek
PAYETTE
SOUTH FORK
Bonneville Hot Springs WARM SPRINGS REC SITE
CAMP CREEK SUMMER HOMES AREA
CAMP CREEK REC SITE
BEAR CREEK SUMMER HOMES
BEAR CREEK REC SITE
WAPITI CREEK REC SITE
WAPITI CREEK SUMMER HOMES AREA
WARM SPRINGS LANDING FIELD
WARM SPRINGS GS
Blue Joy Creek
Chapman Creek
MacDonald Creek
Wapiti Creek
10824
10828
10079
10078
10077
1147
1159
1160
1157
25
21
48

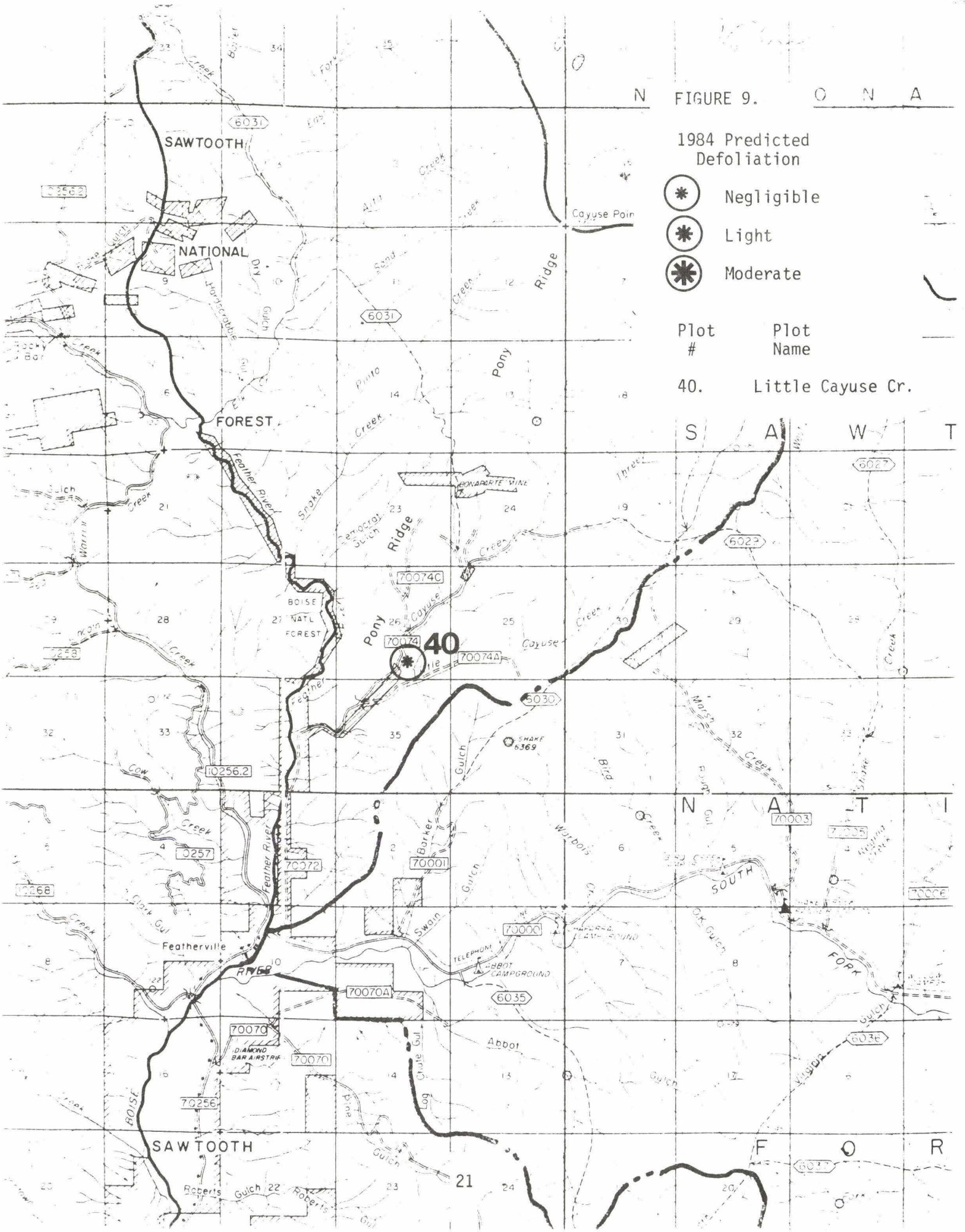


FIGURE 9.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
40. Little Cayuse Cr.
40
SAWTOOTH
NATIONAL
FOREST
Featherville
SAWTOOTH
Cayuse Point
Pony Ridge
Pony Creek
Feather River
Boise Natl Forest
Howard Ridge
Abbot
Abbot Campground
South Fork
Roberts Gulch
Diamond Bar Airstrip
6031
6027
6022
6030
6035
6036
70074C
70074
70074A
70072
70001
70000
70003
70070
70070A
70256
10256.2
10257
10258
10268

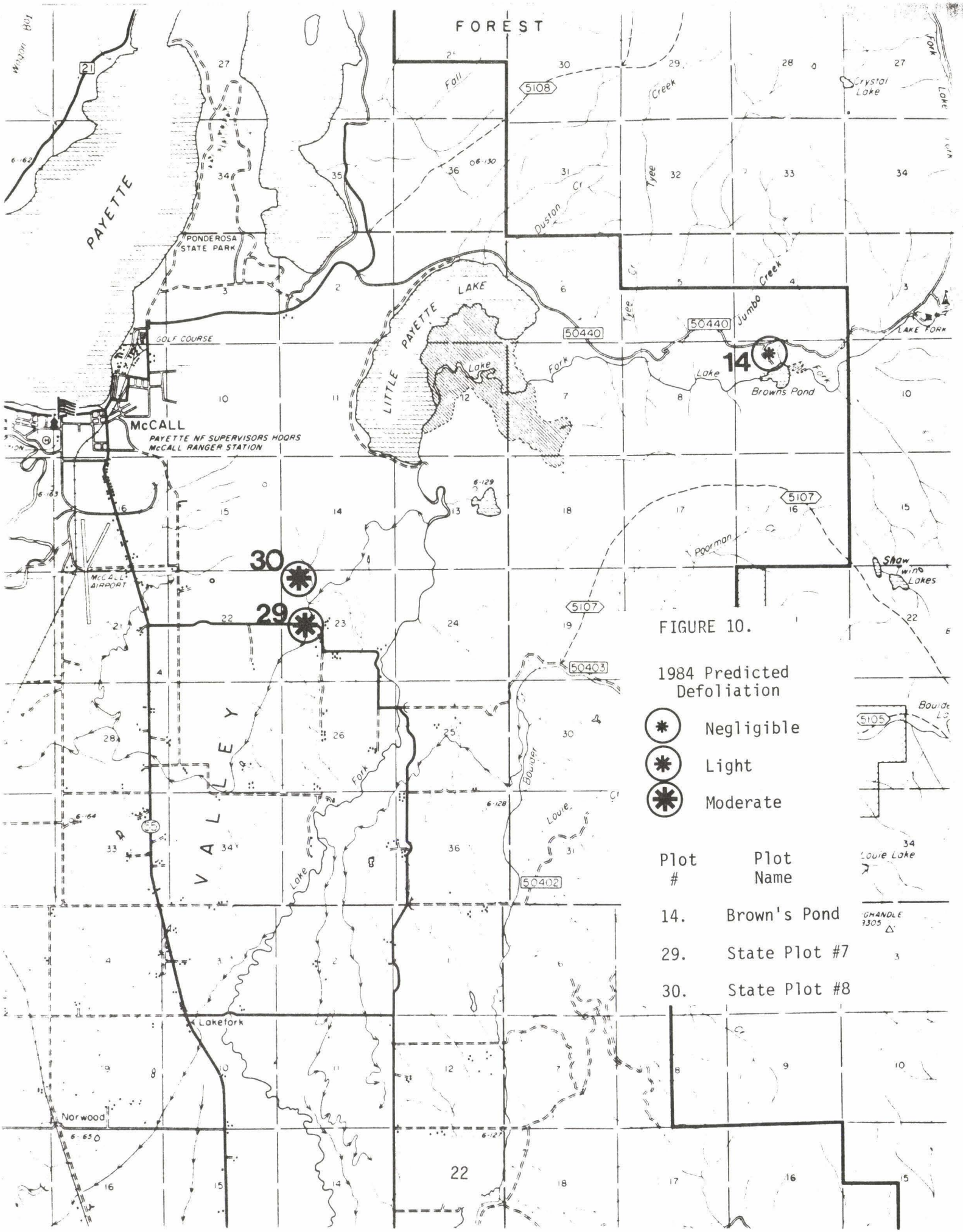


FIGURE 10.

1984 Predicted Defoliation

- Negligible
- Light
- Moderate

Plot #	Plot Name
14.	Brown's Pond
29.	State Plot #7
30.	State Plot #8

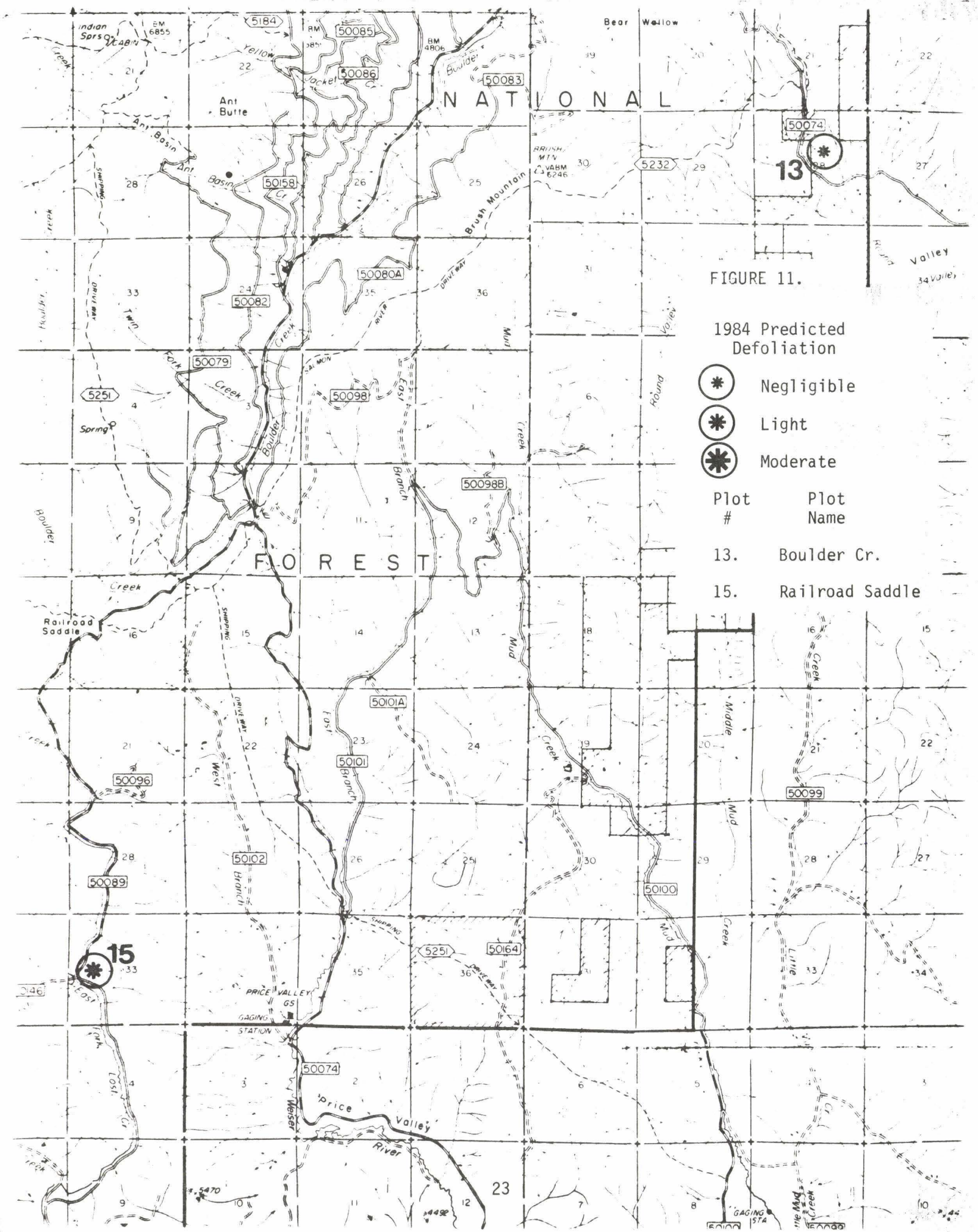


FIGURE 11.

1984 Predicted Defoliation

- * Negligible
- * Light
- * Moderate

Plot #	Plot Name
13.	Boulder Cr.
15.	Railroad Saddle

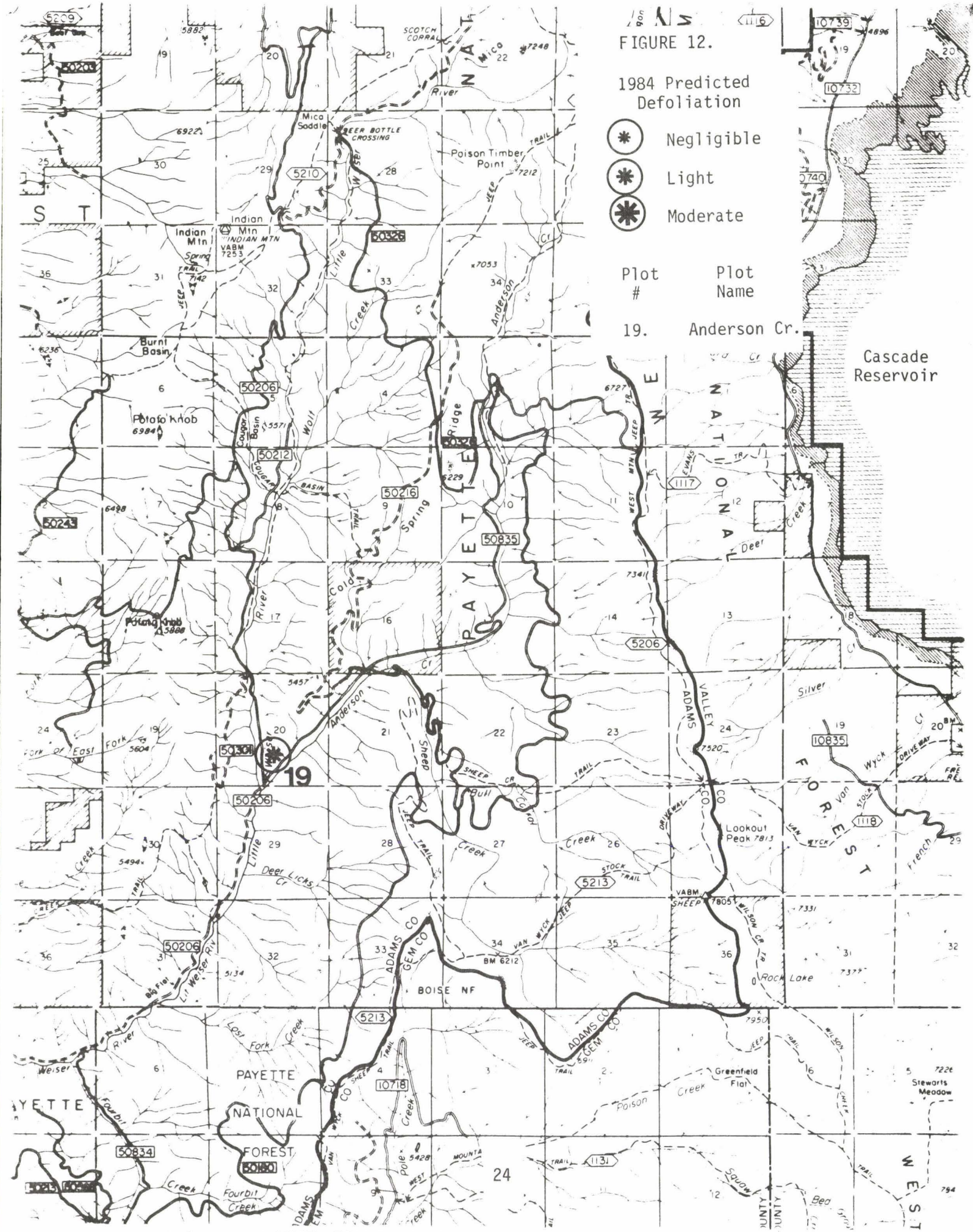
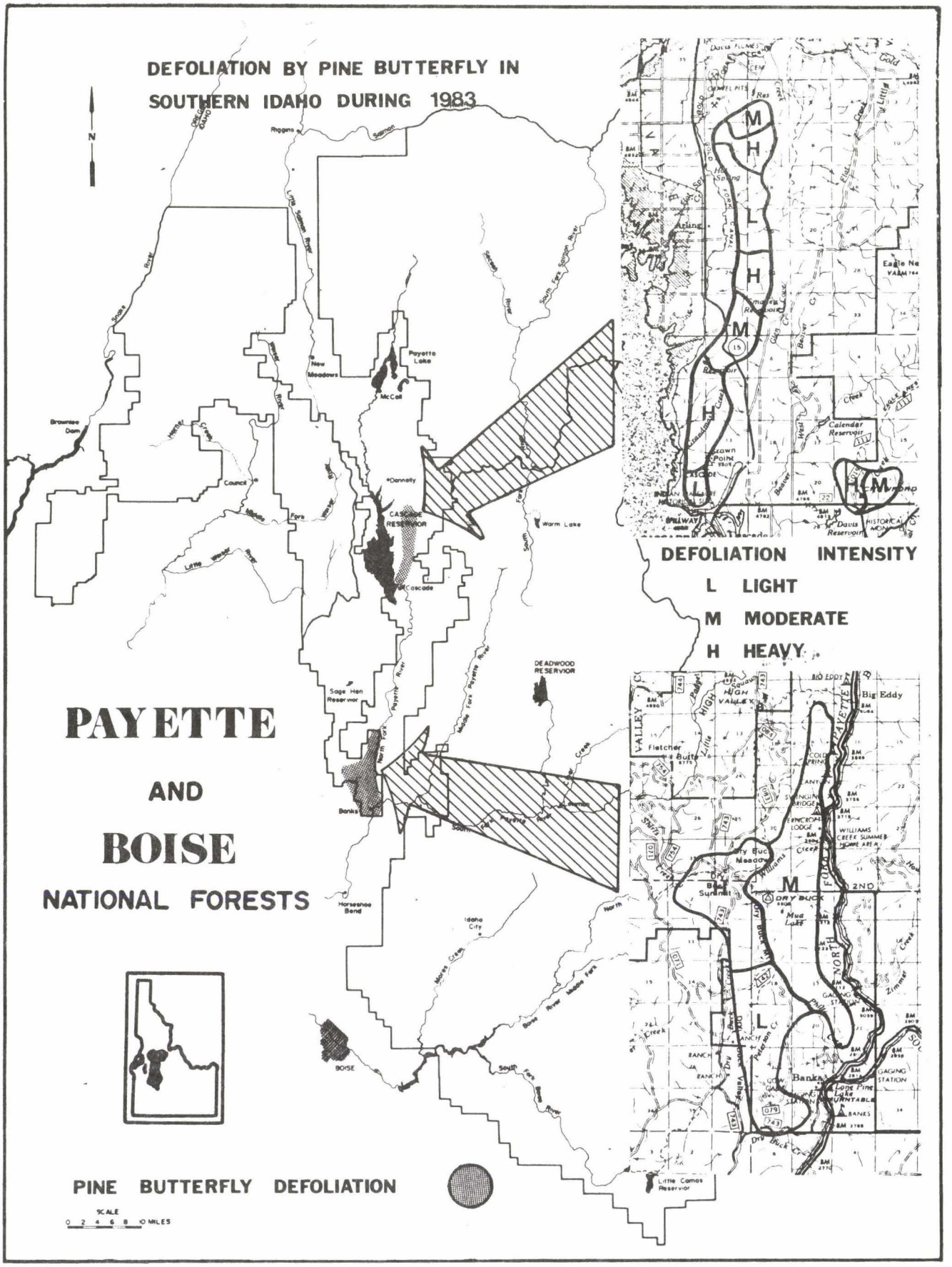


FIGURE 12.
1984 Predicted Defoliation
Negligible
Light
Moderate
Plot # Plot Name
19. Anderson Cr.
Cascade Reservoir
Mica Saddle
Beer Bottle Crossing
Poison Timber Point
Indian Mtn
Burnt Basin
Potato Knob
Cougar Basin
Ridge
Anderson Cr.
Little Creek
Cold Spring
Deer Cr.
Silver Cr.
Lookout Peak 7813
Rock Lake
Greenfield Flat
Stewarts Meadow
Poison Creek
Fourbit Creek
Pole Creek
Deer Licks Cr.
Big Flat
Lost Fork Creek
Weiser River
Adams Valley
Van Wyck
Bull Run Creek
Sheep Creek
Wilson Cr.
Squaw Creek
PAYETTE NATIONAL FOREST
BOISE NF
ADAMS CO
GEM CO
50206
50212
50216
50243
50301
50835
50834
50180
5206
5210
5213
1117
1118
1131
10718
10835
24

FIGURE 13.


DEFOLIATION BY PINE BUTTERFLY IN
SOUTHERN IDAHO DURING 1983
N
PAYETTE
AND
BOISE
NATIONAL FORESTS
DEFOLIATION INTENSITY
L LIGHT
M MODERATE
H HEAVY
PINE BUTTERFLY DEFOLIATION
SCALE
0 2 4 6 8 10 MILES
Payette Lake
McCall
New Meadows
Cascade
Cascade Reservoir
Deadwood Reservoir
Sage Hen Reservoir
Horseshoe Bend
Idaho City
Boise
Banks
Warm Lake
Big Eddy
Calendar Reservoir
Davis Reservoir
Little Camas Reservoir